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ABSTRACT

Education in the U.S.S.R. is much more strongly oriented toward the scientific and technical fields than is that of the United States. This may be an asset in the development of specialists with the ability to attain the short-term technological targets of the Soviet economic plan. However, the more flexible, theoretical, broader-based higher education system in the United States may produce specialists with an ability to innovate, with an ability to adapt to technological change, and with a greater latitude for interfield mobility as the demands of the economy change. A comparative analysis is presented of: (1) the structure of education in the two countries; (2) general education--elementary and secondary; (3) transition from incomplete to complete secondary education; (4) specialized secondary schools; (5) higher education; and (6) graduate training. A set of statistical tables providing a quantitative comparison of entrance, enrollment, and completion of the various stages in the educational process in the two countries is appended. (JD)

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A SUMMARY REPORT ON THE EDUCATIONAL SYSTEMS OF THE UNITED STATES AND THE SOVIET UNION: COMPARATIVE ANALYSIS

March, 1980

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Francis W. Rushing

U.S. DEPARTMENT OF EDUCATION
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A SUMMARY REPORT ON THE EDUCATIONAL SYSTEMS OF THE UNITED STATES AND THE SOVIET UNION: COMPARATIVE ANALYSIS

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Summary and Conclusions

The clearly enunciated approach of the Soviet leadership for meeting the long-term future is firmly based on the application of the achievements of science and technology in all areas of development of the bases of state power.[1] An integral part of this doctrine is the restructuring of the skill levels of the labor force--a qualitative approach which is intended to provide the most effective avenue to the quantitative improvements in the economic sphere. The Soviet Union has made remarkable strides in its goal of raising the quality of its work force to bring about the scientific and technological transformation of the economy. The level of educational attainment of the population as measured by number of years of training completed has risen from 5.9 years in 1960 to 8.7 years in 1977, and is projected to rise to 9.9 years by 1985. (See Appendix Table 1).

When these data are compared to data for the United States, there is still a significant disparity, especially in terms of percentage of population who have completed a higher education (15.4 percent of total population in the U.S. with four or more years of college as opposed to 6.7 percent in the Soviet Union having completed approximately 5 years of higher education). The distribution of the Soviet population at the higher levels of education, however, is far more heavily skewed toward the scientific and technical fields than is that of the United States. This emphasis can be expected to continue into the future.

This report has attempted to describe some of the general characteristics of the educational system of the USSR in contrast to that of the United States, particularly insofar as such characteristics affect the training offered by the two systems in science and engineering. The following general comments can be made.

- U.S. elementary school students (grades K-6) receive slightly more hours per week in science training than do Soviet elementary school students, but total hours devoted to mathematics at these grades is considerably below the average for the Soviet Union.
- The Soviet secondary school curriculum is quite accelerated in science and mathematics as compared with most curricula in U.S. high schools. The entire school population is exposed to the mathematics-science oriented curriculum in Soviet secondary schools rather than only selected students as is the case in the United States. Thus, in general, the Soviet secondary school graduate has a far better training in mathematics and science than does his U.S. counterpart.
- The Soviet Union has developed a type of education--the secondary specialized school--that provides technical-applied training at the secondary education level and is the principal source of the technical cadre that works under the direction of graduates of higher education, particularly in the engineering fields. Over one million students are graduated from secondary specialized schools annually. There is no equivalent type of training in the United States.

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[1] There is a major caveat regarding the study results: The U.S. has little direct access to classified Soviet research and development activities primarily in the military sector. For that reason, a direct comparison of both the number and quality of all engineers and all scientists is not possible. In addition, some Soviet education and training in military fields is highly classified, further limiting the universe of comparison. This study therefore excluded the military sector.

- The percentage of Soviet secondary school graduates admitted to higher educational establishments has been consistently declining since 1965, so that by 1979 only about one out of every four secondary school graduates was admitted to higher education. In the United States, by contrast, about 75 percent of all high school graduates enter higher educational institutions.

- While the United States has a greater proportion of secondary school graduates entering higher educational institutions than does the Soviet Union, attrition rates are much higher. About 80 percent of those admitted to higher educational establishments in the Soviet Union complete their undergraduate education and receive a diploma, whereas only 55 percent of those students who enroll in U.S. colleges go on to receive their bachelors degrees.

- A marked difference in Soviet and U.S. higher education is the heavy Soviet concentration on narrow occupational training. The extremely narrow specialization characteristic of Soviet higher educational training has often been faulted for its failure in providing scientists with the ability to master new knowledge, assimilate new research methods, and cope with technological change. In addition, such narrowly specialized training is highly susceptible to obsolescence and has for this reason been the subject of frequent controversy in the Soviet Union. Nevertheless, this basic pattern of Soviet higher education has remained fundamentally the same since the 1960s.

- Although in the mid 1960s full-time instruction in higher education was given increased emphasis over part-time instruction, approximately 40 percent of Soviet enrollment in higher educational establishments is still in evening and correspondence programs, the quality of which is generally conceded to be substantially below that of full-time programs.

- As a percent of college age population in 1978, the United States had about three times the number of students enrolled at higher educational institutions as did the Soviet Union, and had about one-and-one-half times as many total graduations of the 22/23 year old population. However, in the engineering fields, the Soviet Union graduated almost 6 times the number of specialists at the undergraduate level as did the United States, a difference which is substantial even allowing for the probably inferior instruction of approximately one-third of the Soviet engineering graduates who were enrolled in part-time programs.

- The level of attainment of science and engineering graduates of full-time programs in Soviet higher educational establishments appears to be about the same as, or occasionally higher than the level of attainment of science or engineering graduates at the bachelors level in the United States.

- About 75 percent of Soviet graduate student (aspirant) enrollment is in the science and engineering fields. The percentage of total U.S. masters and doctorate enrollment in these fields has been steadily declining since 1960, and was about 20 percent in 1974 (the latest year for which comparable Soviet data are available).

- The Soviet Union and the United States now have approximately the same number of specialists with advanced degrees (Candidate of Science or Doctor of Science in the USSR and doctorate degrees in the U.S.). However, the Soviet Union has more specialists with advanced degrees in the physical and life sciences than does the United States, and has more than twice the number of engineers with advanced degrees. The United States leads the Soviet Union in the number of specialists with advanced degrees in only the social sciences and humanities.

Thus, Soviet education is much more strongly oriented toward the scientific and technical fields than is that of the United States. Doubt can be raised, however, as to the "staying power" of this education. While the high degree of specialization and applied functional orientation of the Soviet higher educational process may be an asset in the development of specialists with the ability to attain the short-term technological targets of the Soviet economic plan, the more flexible, theoretical, broader-based education received in U.S. higher educational institutions may produce specialists who are better prepared to meet the longer term goals of a society with an ability to innovate, an adaptability to technological change, and a greater latitude for interfield mobility as the demands of the economy change.

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The Structure of Education in the U.S. and the U.S.S.R.

The contrast between the U.S. and Soviet educational structures clearly reflects the differences in the goals and objectives of education within the two political/economic systems. The Soviet educational structure is essentially designed to provide educated persons to the labor pool for the national economy. To meet those requirements, the U.S.S.R. has established a national structure of education, with standardized curricula and common examination procedures. This contrasts directly with the U.S. system which is neither centralized nor standardized (although there are general characteristics which tend to permeate the system), and where the goals of the individual are of equal or greater importance than those of the state.

The structure of the Soviet educational process reflects the regime's response to changing Soviet demography and changing requirements of the Soviet economy. Economic and demographic problems have forced the U.S.S.R. to base its future economic well-being on rapid technological change and higher efficiency. Thus, Soviet general education is designed to get students into the work force at an early age with sufficient science and mathematics background to permit them to function productively in a changing high-technology economy. The Soviet leadership makes available to its citizens many opportunities for education and training during both their pre-employment and post-employment years, and attempts to ensure that the best students are admitted to higher educational institutions and eventually to graduate training.

Figure 1 depicts the general structures of the U.S. and Soviet educational systems. Both systems start formalized education at the age of 6-7 and finish higher education by age 21-22. Each is based on the concept of compulsory elementary and secondary education to ages 15-16 and each has a high degree of participation in the educational process. The U.S. system, however, has a more general hierarchical structure, with a broader curriculum in which specialization does not take place until higher education. In the Soviet system, on the other hand, specialization begins to occur at the specialized secondary school and in the extensive network of vocational-technical schools, or at about 16 years of age. This specialization continues into higher education.

General Education--Elementary and Secondary

The most dramatic difference between the educational systems of the Soviet Union and the United States is with regard to their curriculums--particularly the general educational curriculum which spans grades 1-10.[1] As the curriculum at these grades is the basis upon which subsequent curricula are built, it should be reviewed in some detail.

Figure 2 summarizes the Soviet curriculum for grades 1-10, breaking it down as the Soviet schools do into primary (grades 1-3), incomplete secondary (grades 4-8) and general secondary (grades 9-10) education. Perhaps the greatest contrast between U.S. and Soviet curricula at this level is the Soviet emphasis on science and mathematics and the grades at which they are introduced. Mathematics is introduced at grade 1, biology at grade 5, physics at grade 6, and chemistry at grade 7. At the terminal point in the "incomplete secondary training" (grades 1-8), all students have already completed eight years of mathematics, three years

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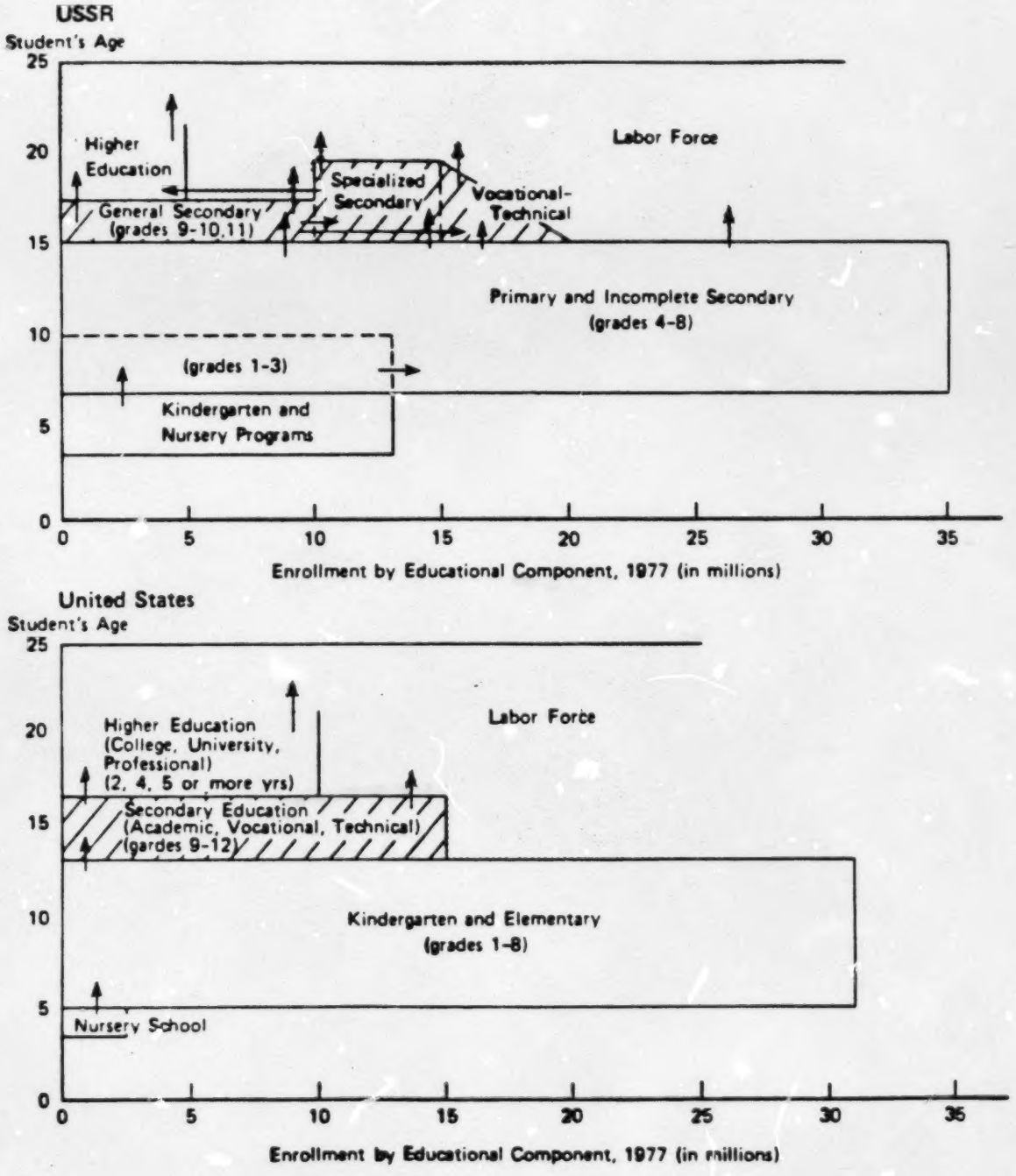
[1] In some Republics where instruction is not in Russian, an eleventh grade may be added to ensure that students are proficient in Russian upon completion of their general education.

Figure 1

The Structure of Education in the Soviet Union and the United States



Source: USSR: Trends and Prospects in Educational Attainment 1959-85, p. 3, CIA ER 79-10344, (June 1979).

Subjects / Grades	Primary School				Eight-Year School				10-Year Complete Secondary School		Total Weekly Hours
	I	II	III	IV	V	VI	VII	VIII	IX	X	
Russian language	12	11	10	6	6	4	3	2	-	-	54
Literature	-	-	-	2	2	2	2	3	4	3	18
Mathematics	6	6	6	6	6	6	6	6	5	5/4	57.5
History	-	-	-	2	2	2	2	3	4	3	18
Basics of Soviet Government & Law	-	-	-	-	-	-	-	1	-	-	1
Social Science		-	-	-	-	-	-	-	-	2	2
Natural Science	-	1	2	1	-	-	-	-	-	-	4
Geography	-	-	-	-	2	3	2	2	2	-	11
Biology	-	-	-	-	2	2	2	2	1	2	11
Physics	-	-	-	-	-	2	2	3	4	4/5	15.5
Astronomy	-	-	-	-	-	-	-	-	-	1	1
Drawing	-	-	-	-	-	-	1	1	-	-	2
Foreign language	-	-	-	4	3	2	2	1	3	1	14
Chemistry	-	-	-	-	-	-	2	2	3	3	10
Fine Arts	1	1	1	1	1	1	-	-	-	-	6
Singing and Music	1	1	1	1	1	1	1	-	-	-	7
Physical Training	2	2	2	2	2	2	2	2	2	2	20
Manual Training	2	2	2	2	2	2	2	2	4	4	24
Primary military training	-	-	-	-	-	-	-	-	2	2	4
Total required courses	24	24	24	27	29	29	29	30	32	32	
Elective courses							2	3	4	4	13
Grand Total											

Source: Courtesy of Professor Nicholas DeWitt, National Academy of Science, National Research Council; forthcoming report on Science Education in the USSR.

Figure 2 TYPICAL USSR GENERAL EDUCATION SCHOOL CURRICULUM (GRADES 1-10), PROPOSED FOR 1980/81

of physics, and two years of chemistry. In addition, the Soviet student has had five years of foreign language training. Those students electing to enter the general secondary curriculum (grades 9-10), will continue the mathematics/science oriented program. Those students entering specialized secondary institutions will focus on those mathematics and science disciplines which are most appropriate for their field of specialization.

The average number of hours per week devoted to mathematics, science, and social studies in the elementary school in the U.S.[1] and the U.S.S.R. are shown below:

	U.S.	U.S.S.R.	U.S.	U.S.S.R.
Grade Range	K-3	1-3	4-6	4-6
Mathematics	3.2	6.0	3.7	6.0
Science	1.6	1.0	2.9	2.3
Social Studies	1.8	-	3.3	1.7

U.S. elementary school students receive slightly more hours per week in science training than do Soviet elementary students. The accelerated training in mathematics in the Soviet Union at the elementary grades, however, is in sharp contrast to the time spent on these subjects in U.S. elementary schools. Although the emphasis on mathematics in U.S. elementary schools increases in grades 4-6 as compared with grades 1-3, total hours devoted to mathematics are still considerably below the average for the Soviet Union during the same grades.

The Soviet mathematics curriculum provides the student who terminates his training at grade 8 with two years of algebra and plane geometry. If the student continues through grades 9 and 10, he will have completed two additional years of algebra and two years of calculus. This curriculum applies to all students in these grades. Findings from a sample survey in the U.S. show that over 56 percent of the school systems require no or only one mathematics course for graduation. Changing enrollment patterns for courses in secondary schools in the U.S. do seem to reveal, however, more and better mathematics training for some students, especially advanced college-bound students; these students generally complete a calculus course and perhaps a course in probability and statistics. For most students the general level of education in the United States seems to provide at least some training in general mathematics, geometry, and algebra (basic and advanced).

In terms of the amount of time spent on science instruction after grade 6, there is also a sharp contrast between the Soviet and U.S. school program. In the junior high schools and senior high schools in the U.S., science instruction is offered through courses, which are generally offered on a full year basis. The most common science courses offered in grades 7-9 in descending order are: general science, earth science, life science, physical science, and biology. General science is the only science course offered by more than 50 percent of all the schools with grades 7-9. In grades 10-12, the most frequently offered courses are: biology, chemistry, and advanced biology. However, only a few students take chemistry and very few of only the most able students take physics.

The sharp contrast between the Soviet 10-year school curriculum and the broader American elementary-secondary education reflects in part the general differences between the American and the European educational system, after which the Soviet Union modeled its curriculum. As opposed to the European system, however, the

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[1] See "The Status of Pre-College Science, Mathematics and Social Studies Educational Practices in U.S. Schools", NSF-SE-78-71.

mathematics and science emphasis of the Soviet educational system is not tailored to selected students but to the entire school population. Thus, all students are exposed to the mathematics-science oriented curriculum; some excel and go on through the system to higher education, others are channeled into specialized secondary or vocational-technical school, and some simply terminate their education and enter the labor force.

Soviet educational policy has the objective during the first eight years of the educational program of ensuring that the future labor force is exposed to science and mathematics in order to facilitate the Soviet goal of rapid transformation of the economy to a scientific-technical base. This goal is also consistent with the requirement for better trained and more technologically-oriented persons to fill the ranks of the Soviet military. However, comparative statements on science and mathematics training in the U.S. and U.S.S.R. should not be allowed to totally eclipse some important arguments for the well rounded, more diverse curriculum which is important to the intellectual and social development of students who will live in an inter-related, multi-cultural world. In addition, the mathematics/science orientation of the Soviet general curriculum does not necessarily result in a high level of competency among the total population. The evidence presented in the Soviet literature suggests that the quality of instruction is not uniformly good. For instance, there is a wide disparity in the quality of instruction in urban as opposed to rural schools and in the RSFSR as opposed to the southern, non-Russian republics. In addition, Soviet student/teacher ratios for grades 1-10 are high by U.S. standards, with 30-40 students for each teacher, and Soviet schools still have problems with facilities, particularly laboratories. In general, however, Soviet secondary school students receive a far better preparation in science and mathematics than do their U.S. counterparts.

Transition from Incomplete to Complete Secondary Education

Soviet students have four principal options upon completion of grades 1-8 (see Figure 1). One option is to continue general secondary education to prepare for the entrance examinations for higher educational institutions. A second is to enter the specialized secondary institutions which provide the student with the final two years of secondary education plus two to three additional years in specialized post-secondary instruction. The curricula of these institutions prepare the student as a technician in one of a number of specialties which will permit him to be employed within the pertinent sector of the economy. A third option is vocational-technical education. The curricula for vocational-technical institutions focus on the training of skilled manpower. The system provides course work to complete the secondary educational program if the student has not already done so as well as specific training in vocational-technical fields. Under the fourth option, students, particularly those whose academic performance has not been up to standards or who elect for a variety of reasons not to pursue the other options (for instance, youth in rural sections of the U.S.S.R.), enter directly into the labor force as unskilled workers.

General secondary education has historically been the educational path for students desiring to go directly into higher education. However, the percentage of graduates of general secondary education actually admitted to higher educational establishments has been falling from 63.7 percent in 1965 to 25.9 percent in 1979 (see Appendix Table 3). Those general secondary school graduates who were not admitted to higher educational establishments entered either specialized secondary schools, sought vocational-technical training, or in some cases simply awaited another opportunity to take entrance examinations while neither in school nor in the labor force. Soviet educational specialists have been critical of students remaining outside the labor force while seeking admission to higher education, and authorities have attempted to make alternative educational options attractive.

However, in the Soviet society, upward mobility within the system is dependent upon education, and a diploma from a higher educational institution opens up opportunities for mobility.

Specialized Secondary Schools

Specialized secondary schools are quite different, both conceptually and organizationally, from institutions in the United States. These schools provide technical training to both eighth and tenth grade graduates and offer both full-time and part-time programs. In 1977, there were 4.7 million persons in specialized secondary schools, 62 percent of whom were full-time students. Specialized secondary schools graduate persons in a wide range of specialties. The curriculum for the eighth grade entrants involves about 75 percent technical-applied training and the program is about four years in duration. Tenth grade graduate entrants are trained in technical skills and their programs are between 1 1/2 to 2 1/2 years in duration, depending on the technical specialties.

Specialized secondary school graduates are the principal source of middle level personnel in Soviet industry, and form the technical cadre that generally works under the direction of graduates of higher education, particularly in the engineering fields. The Soviet regime has emphasized this type of training in order to infuse the economy and its associated research and development institutes with a trained cadre of scientific and technical workers.

Appendix Table 4 shows the number of students enrolled and graduated from Soviet specialized secondary schools by specialty from 1960-1979. Specialized secondary programs are likely to continue to expand, although demographic factors will probably slow the rate of increase and the number and kinds of specialties will probably change. In recent years, the specialty with the highest growth rate in enrollment and graduation has been economics, while there has been little change in enrollment and graduation in the engineering specialties. The increase in economics reflects the increased emphasis in industry on effective planning and efficient production techniques.

The types of education in the United States that are most comparable to Soviet specialized education are those of the associate engineering programs in technological colleges and the specialized technical training included in practical nursing, laboratory technician, and mechanical technologist programs. In the case of associate engineers, 2- to 3-year programs have often been undertaken by persons desiring to enter 4-year engineering schools; some persons do not seek admission to 4-year colleges or universities and terminate their training with an associate degree of engineering.

Higher Education

Higher education in the Soviet Union is highly functionally oriented, and essentially involves narrow specialized training designed to serve practical, applied ends. The student's field of study at a higher educational establishment is designated by the term "specialty". Students choose a specialty at the time they apply for admission to a higher educational establishment, and, once admitted, follow a rigidly defined program of study preparing them for a professional occupation in that specialty. Professional specialization in the U.S.S.R. is considered to be far more pronounced than in almost any other country in the world. In contrast to the liberal arts and other non-professionally oriented programs common in American colleges and universities, higher educational programs in the Soviet Union are <u>all</u> professionally oriented, involving a degree of specialization even greater than that in the functionally-oriented courses of study in professional schools in the United States.

Currently, there are about 360 specialties offered by Soviet higher educational establishments. These are combined in 22 different specialty groups, which in turn are organized according to five branches: engineering-industrial, agricultural, socio-economic, health and medicine, and education and cultural. Mechanical engineering and instrument construction, for example, is a specialty group within the engineering-industrial branch; within the mechanical engineering group, there are 46 different specialties (such as semi-conductor and electro-vacuum engineering, mining machinery and outfits, boiler construction and hydro-aerodynamics) which constitute the student's actual field of study. Over 200 of the specialties offered in Soviet higher educational establishments are in the engineering-industrial branch.

The extremely narrow specialization characteristic of Soviet higher educational training has often been faulted for its failure in providing scientists with the ability to master new knowledge, assimilate new research methods, and cope with technological change. In addition, such narrowly specialized training is highly susceptible to obsolescence and has for this reason been the subject of frequent controversy. Most recently, the need for more flexible curricula and greater emphasis on general theoretical background in the training of "broad-spectrum" specialists was called for in a decree on higher education issued in July of 1979. Despite the debate that has often surrounded the issue of whether higher education should train narrow specialists or personnel with a wider range of knowlege, the basic pattern of higher education in the Soviet Union has remained fundamentally the same as in the 1960s.

Soviet higher educational establishments are essentially of two types: universities and institutes. Universities generally offer programs of instruction in a variety of fields, primarily in the natural and social sciences, while institutes usually concentrate on a single area of related specialties specifically oriented toward a given sector of the economy, agriculture or medicine. The training provided by universities is generally somewhat broader and of a more theoretical nature than that provided by institutes. From among the 22 specialty groups of higher educational programs in the Soviet Union, a group referred to as 'university specialties' is singled out as a discreet category. Specialties in this category, which include physics, mathematics, biology, etc. as well as social sciences and humanities, appear to have a greater similarity to fields of study pursued by students in U.S. colleges and universities than do many of the more narrow, applied specialties offered in Soviet institutes. Even in the university specialties, however, higher education in the Soviet Union is far more functionally oriented than in the U.S., but is in this case designed with a view toward professional occupations in basic research or teaching as opposed to the more narrowly applied industrial orientation of most other specialties in the U.S.S.R.

Of a total of 856 higher educational establishments in the U.S.S.R. in 1975, there were 63 universities. Over the last three decades, Soviet universities have fairly consistently accounted for about 12 percent of the total number of graduates from higher educational establishments. While the percentage of graduates from higher educational establishments that have been trained in universities is relatively small, university training is generally considered to be qualitatively superior to training received in institutes.

There are three basic types of instruction programs offered in Soviet higher educational establishments: regular day, evening, and extension-correspondence. The latter two involve part-time study and are frequently comprehended under the term "without time-off from production". Evening and correspondence programs, while employing identical teaching methods as full-time programs, differ in intensity and amount of time devoted to instruction. The quality of part-time programs,

especially of the extension-correspondence type, has been questioned because of high drop-out rates, excessive absenteeism, and probably inferior instruction. One U.S. analyst states categorically that the engineers trained in such programs "would not be considered to be professionally trained engineers in the United States."[1] The advantages of this type of education to Soviet planners is that it allows the channeling of a large number of young people toward the pursuit of higher education while not removing them from the labor force. It also allows for a substantial reduction in the cost of education to the state, as students engaged in part-time programs are for the most part self-supporting.

At the end of the 1950s and early 1960s, evening and correspondence education had become the predominant means of training specialists in Soviet higher educational establishments, accounting for 51.7 percent of total enrollment in the 1960-61 academic year and 58.9 percent by 1965-66 (see Appendix Table 6). In the mid-1960s, however, full-time instruction was given increased emphasis, so that by 1975, enrollment in evening and correspondence programs had fallen to about 46.5 percent of total enrollment, and the ratio of first-year part-time students had decreased to about 40 percent of the total. Soviet sources admit that this increased emphasis on full-time instruction beginning in the mid-1960s was at least in part in recognition of qualitative advantages of full-time educational programs.

The United States has no higher educational programs that are comparable to the Soviet extension-correspondence type programs. Although many students obtain their higher education through part-time study, the distinction between part-time and full-time students in the United States is made only on the basis of the number of courses in which a student is enrolled during any particular semester. The overall requirements for obtaining a degree are the same for part-time as for full-time students, and part-time students are not singled out to attend different classes with different instructors from full-time students. Thus, the level of qualification of individuals who obtain a degree through part-time study does not differ from that of individuals who obtain a degree through full-time study.

Students who desire to enter Soviet higher educational establishments must have completed their secondary education, whether in general educational, vocational-technical, or specialized secondary schools. Students are chosen competitively, on the basis of competitive entrance examinations as well as marks in secondary school. In contrast to the standardized national entrance examinations, such as the Scholastic Aptitude Test and the American College Testing Program's assessment tests, that often serve as extremely important admissions criteria for many U.S. colleges and universities, Soviet entrance examinations are exclusively of the achievement-test rather than aptitude-test variety (the latter were officially banned in 1936). As individual institutions formulate their own examination questions, they can vary their own standards of admission. Depending on the higher educational establishment, examinations are required in three to five subjects from among the following: Russian language and literature, mathematics, physics, chemistry, history, geography, foreign languages.

Annual quotas on admissions for each specialty within each higher educational establishment are determined by the central government on the basis of a demand schedule for various specialists in the national economy. Every application to a higher educational establishment must be accompanied with the applicant's personal documents and must specify the specialty for which he is seeking to gain admission. Thus, only one application can be made at any one time. Taking the

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[1] David W. Bronson, "Scientific and Engineering Manpower in the USSR and Employment in R&D", in Soviet Economic Prospects for the Seventies, p. 564, Joint Economic Committee (U.S. Congress, June 1973).

U.S.S.R. as a whole, quotas probably function as a more important determinant of the overall academic ability of all students admitted to higher educational establishments than do entrance examinations, in that at those higher educational establishments that receive relatively few applications compared with the number of places available, less qualified applicants are admitted so as to fill the admissions quotas.

While all students who have completed a secondary education are eligible to apply for admission to higher educational establishments in the Soviet Union, the general secondary schools are essentially the training ground for higher education. Appendix Table 3 shows the percentage of secondary school graduates who are admitted to higher educational establishments. As the percentage is based on the number of graduates of general secondary schools only while the admissions figures include graduates of secondary specialized and vocational-technical schools as well as some students who graduated from secondary schools in preceding years, the percentage of admissions is probably somewhat exaggerated. The percentage of those secondary school graduates who are admitted to higher education has been consistently declining since 1965, so that in 1979 only about one out of every four secondary school graduates was admitted to a higher educational establishment. In the United States, by contrast, from about 75 percent of all high school graduates enter higher educational institutions. On the other hand, while the United States has a greater proportion of secondary education graduates entering higher educational institutions than does the Soviet Union, attrition rates are much higher. About 80 percent of those admitted to higher educational establishments in the Soviet Union complete their undergraduate education and receive a diploma, whereas only about 55 percent of those students who enroll in U.S. colleges go on to receive their bachelors degrees.

In the Soviet Union, an academic program, specifying the sequence of courses, the distribution of theoretical and practical work, the length of time of instruction, examinations, and so forth is formulated for each specialty by the central government, although individual higher educational establishments have authority to introduce minor changes. Academic programs are designed to equip the student to perform a given occupational job depending on the specialty. The length of training from the time of entering the higher educational establishment to receipt of the diploma is from four to five-and-a-half years. Most of the science and engineering specialties involve four-and-a-half to five years of training.

Academic programs generally contain from 40 to 50 different courses or subjects which the student must complete. These subjects are organized into cycles: socio-economic, general scientific, and specialized. In the higher educational institutes in the engineering-industrial branch, a general engineering cycle is included in addition to the other three cycles.

General theoretical disciplines, including mathematics, physics and chemistry, are covered during the first three to three-and-one-half years of the higher educational program. Following the first phase of higher education, more intensive study directed toward the narrow field of specialization is undertaken. In the academic program for the physics specialty, for example, the general scientific cycle includes courses in mathematics, general physics, astronomy, theoretical physics, methods of solving applied problems on a computer, and the basics of radio electronics. The specialized cycle includes courses such as low temperature physics, molecular physics, optics and spectroscopy. During the last half-year of the higher educational program, students prepare for state examinations or for defense of a diploma project (similar to a thesis) before the state examination board. The instruction time in most Soviet higher educational programs is usually one-and-a-half to two times as great as that in the U.S. colleges and universities.

In detailed comparisons of physics curricula as offered in Soviet universities and in major U.S. universities (M.I.T. and Columbia) in the mid-1950s, the authors concluded that the science content of the Soviet 5-year physics curricula examined compared favorably with that offered by the best U.S. universities.[1] They found that the Soviet physics curricula were well structured, building on a broad theoretical foundation in the earlier years of study to a highly sophisticated level of specialized training in the last year of study that is not usually included in U.S. education prior to the first or second year of the graduate school program. These conclusions were reaffirmed in a major U.S. study of Soviet education made in 1961.[2] In that study, the author found that, although the general physics curricula of Soviet universities had been restructured since the mid-1950s so as to reduce the number of weeks of instruction and intensify the number of weeks of industrial practice assignments, the academic subject matter content had not been significantly affected by these alterations.

Although comparisons of U.S. and Soviet physics curricula indicated that a specialist who has completed the Soviet 5-year physics curricula (in the regular day program, at least) has a comparable, perhaps somewhat better, professional preparation than a student who has completed four years of college work plus one year of graduate training in physics at a U.S. university, results of studies comparing Soviet to U.S. engineering programs were less conclusive. One author found that, "Discounting the vocationally oriented store of precarious knowledge a Soviet engineering graduate possesses after his five years of training, we conclude that in terms of basic engineering preparation he does not achieve appreciably if at all a higher level of competency in his five years of training than his American counterpart does after a 4-year course."[3] However, another evaluation conducted about the same time, which focused on electrical engineering curricula, found that the level of competency attained by a Soviet student after five-and-a-half years of study corresponded to that of a student who had completed a masters degree at a U.S. university.[4]

Unfortunately, more recent detailed comparisons of curricula in Soviet and U.S. higher educational programs are not available; however, the structure of the Soviet higher educational program does not appear to have undergone any major

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1 Alexander G. Korol, Soviet Education for Science and Technology (Wiley and Sons, 1957); and E.M. Corson, An Analysis of the Five-Year Physics Program at Moscow State University (U.S. Department of Health, Education, and Welfare, 1959).

2 Nicholas DeWitt, Education and Professional Employment in the USSR (National Science Foundation, 1961).

3 Korol, op. cit., p. 357.

4 P.A. Abetti and G.F. Lincks, Electrical Engineering Education in the USSR, as cited by DeWitt, op. cit., p. 785.

changes that would call into question the conclusions of these earlier studies.[1] The substantive variations in Soviet undergraduate training from field to field as well as fundamental differences in orientation from U.S. undergraduate programs make direct overall comparisons of the quality of U.S. and Soviet higher education unfeasible. Comparisons of the level of training received in specific specialty areas, however, indicate that the level of professional attainment of a science or engineering graduate of Soviet higher educational establishments (in the full-time programs, at least) is about the same as or occasionally higher than the level of attainment of a science or engineering graduate of a U.S. college or university.

Part-time higher educational programs in the Soviet Union, however, which are generally conceded to offer abbreviated, substandard instruction, still account for approximately 40 percent of total graduation from Soviet higher educational establishments. In addition, while the high degree of specialization and applied functional orientation of the Soviet higher educational process may be an asset in the development of specialists with the ability to attain the short-term technological targets of the Soviet economic plan, the more flexible, broader based education received in U.S. higher educational institutions appears to produce specialists who are better prepared to meet the longer term goals of a society with an ability to innovate, an adaptability to technological change, and a greater latitude for interfield mobility as the demands of the economy change.

Figure 3 shows undergraduate enrollment at higher educational institutions for the United States and the Soviet Union for 1960 to 1978. Figure 4 shows U.S.S.R. diplomas and U.S. bachelors degrees conferred for the same period. From 1960 to 1978, both total enrollment and total graduation from higher educational institutions in the United States showed a greater increase than in the U.S.S.R. In 1978, there were over 10 million students enrolled in undergraduate programs in U.S. higher educational institutions and nearly one million bachelors degrees conferred. In the Soviet Union during the same year, there were about 5 million students enrolled in higher educational establishments and about 770,000 graduations, with part time programs accounting for 38 percent of total graduation. (See Appendix Table 9 for a breakdown of full and part time enrollment by field.) As a percent of college age population, the U.S. had about three times the number of students enrolled at higher educational institutions in 1978 as did the Soviet Union and had about one-and-one-half times as many graduations of the 22/23 year old population. (See Appendix Tables 6 and 7.)

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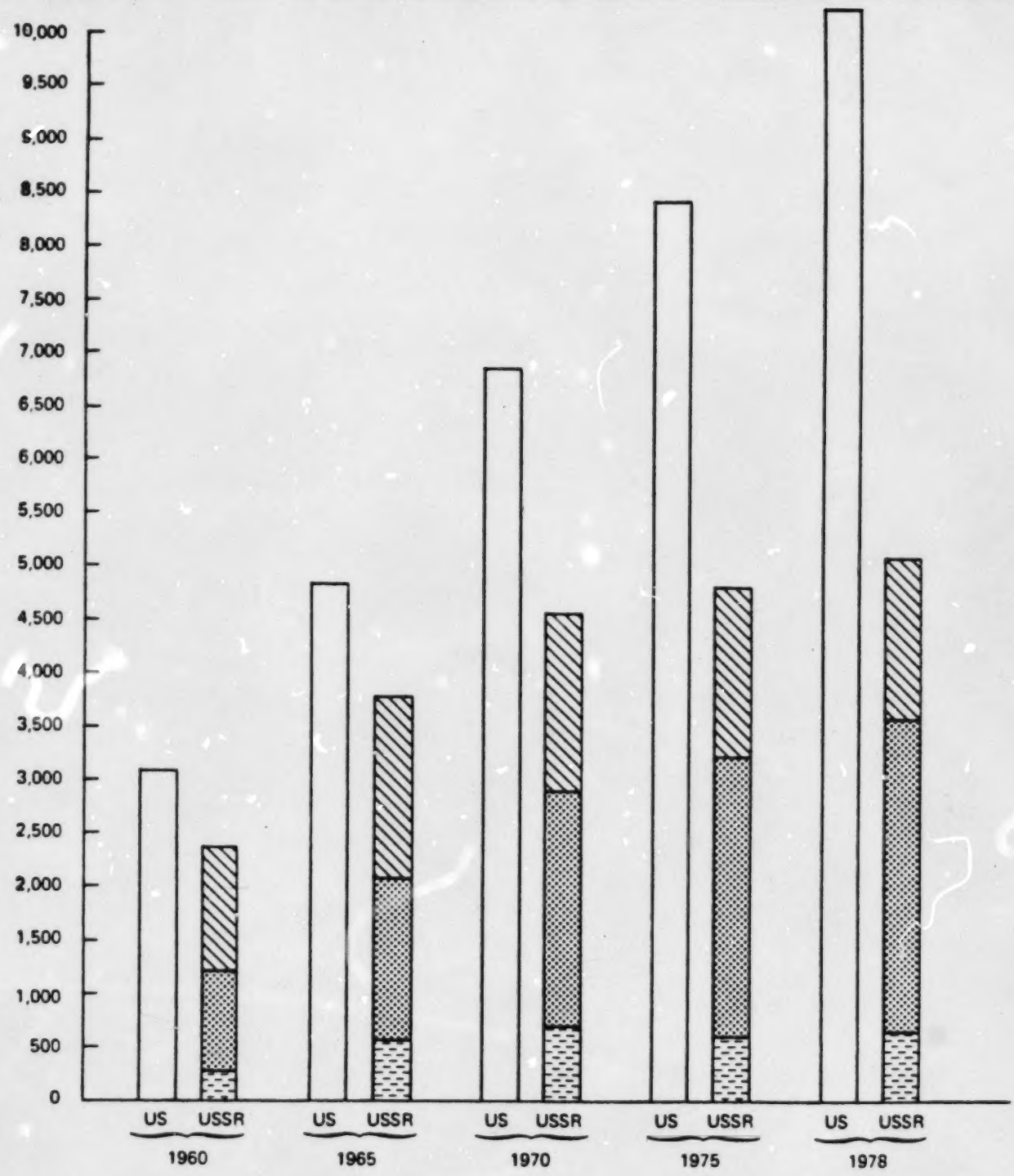
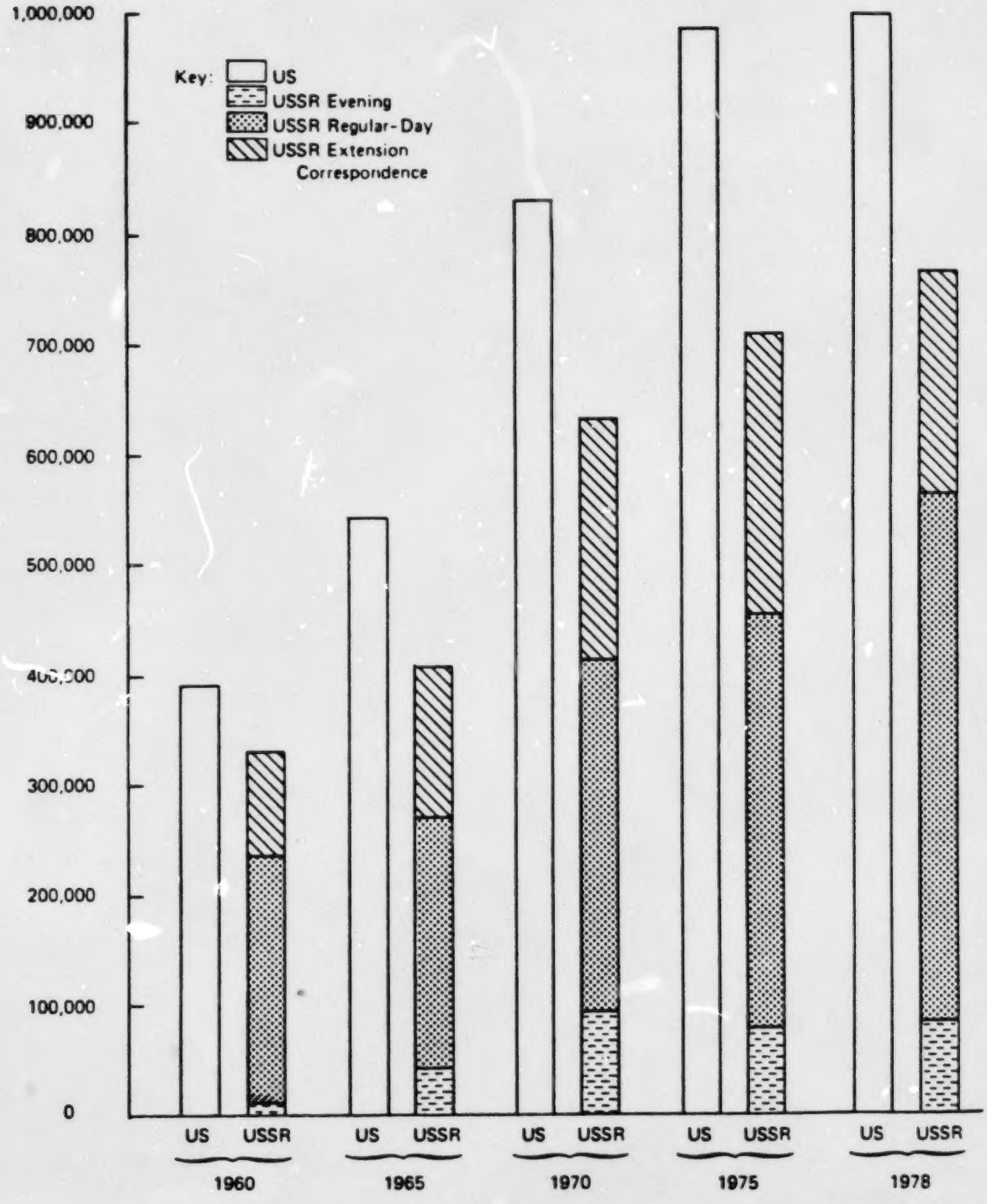
[1] An exchange of detailed curricular materials for physics and chemical engineering was included in the original work plans for the Training and Utilization Subgroup of the U.S.-U.S.S.R. Joint Working Group in the Field of Science Policy. Although the U.S. members of the subgroup provided such materials to the Soviet Union, the Soviet side provided such curricular material for only the social sciences and humanities. Search of available literature during the timeframe for completing the present report did not disclose a current Soviet academic program in the physical sciences or engineering specialties. Thus, while the Soviet members of the subgroup, to whom detailed curricular materials for both countries were presumably available, stated at a joint meeting in 1978 that in their view the requirements for obtaining a masters degree in the U.S. basically corresponded to the requirements for completing an undergraduate education in the U.S.S.R., the Soviet curricular materials necessary to confirm this more recent comparison are not available to the authors of this report.



Source: Statistical Abstract of the United States, 1980; and National Economy of the USSR in 1979.

Key:
- US
- USSR Evening
- USSR Regular-Day
- USSR Extension Correspondence

Figure 3 US AND USSR UNDERGRADUATE ENROLLMENT IN HIGHER EDUCATIONAL INSTITUTIONS: 1960-1978 (In Thousands)



Source: Statistical Abstract of the United States 1980 National Economy of the USSR in 1979.

Figure 4 USSR DIPLOMAS AND US BACHELOR'S DEGREES CONFERRED: 1960 - 1978

Appendix Table 8 shows U.S. bachelors degrees and U.S.S.R. diplomas conferred by major field of study for 1960 to 1979. Data for 1978 are summarized in Figure 5. Figures for Soviet graduates in the physical and life sciences and mathematics are estimates based on two-thirds of graduation in "university specialties" to which graduation in geology-prospecting, geodesy-cartography, and hydrology-meteorology have been added.[1] While there were almost 30 percent more total graduations from undergraduate programs in the United States as in the Soviet Union, in the engineering fields the Soviet Union graduated almost 6 times the number of specialists as did the United States. Even allowing for the probably inferior instruction of approximately one-thrid of Soviet engineering graduates who were enrolled in part-time programs (See Appendix Table 9), the difference is substantial.

While the United States graduates about two times as many specialists in the physical and life sciences and mathematics as does the Soviet Union, in the science and engineering fields as a whole the Soviet Union graduates about twice as many specialists as does the United States (8.6 percent of the 22/23 year old population as opposed to 4.3 percent).

Graduate Training

Soviet graduate training is conducted at universities, other institutions of higher education and at many of the research organizations maintained by Soviet academies of sciences and various industrial ministries. Graduate training is offered by over 2,000 such scientific and higher educational institutions, of which 600 are higher educational institutions. In 1975, graduate training at universities accounted for 26 percent of the training of graduate students.

Two graduate degrees are awarded in the Soviet educational system: Candidate of Science and Doctor of Science. The awarding of the Candidate of Science degree generally occurs after the graduate student has completed an agreed upon course of study and has written and defended a dissertation. There are exceptions to both the course of study and dissertation requirements. The Doctor of Science degree involves no prescribed course of study and is generally awarded in recognition of scientific achievement rather than for completion of a prescribed educational program.

Entrance into formal graduate study (aspirantura) is competitive and based on the results of entrance examinations. Some specialists within the system may seek a Candidate degree without formal instruction by basing their research and dissertation preparation on their professional experience. However, more than 70 percent of those seeking Candidate of Science degrees enter graduate programs as aspirants of the degree.

Graduate education may be pursued while the student is working or the student may be given time off from employment. Full-time graduate study takes three years and must begin before the student is 35 years old. Four years of study are required for those aspirants who do not have time off from production, and the person must

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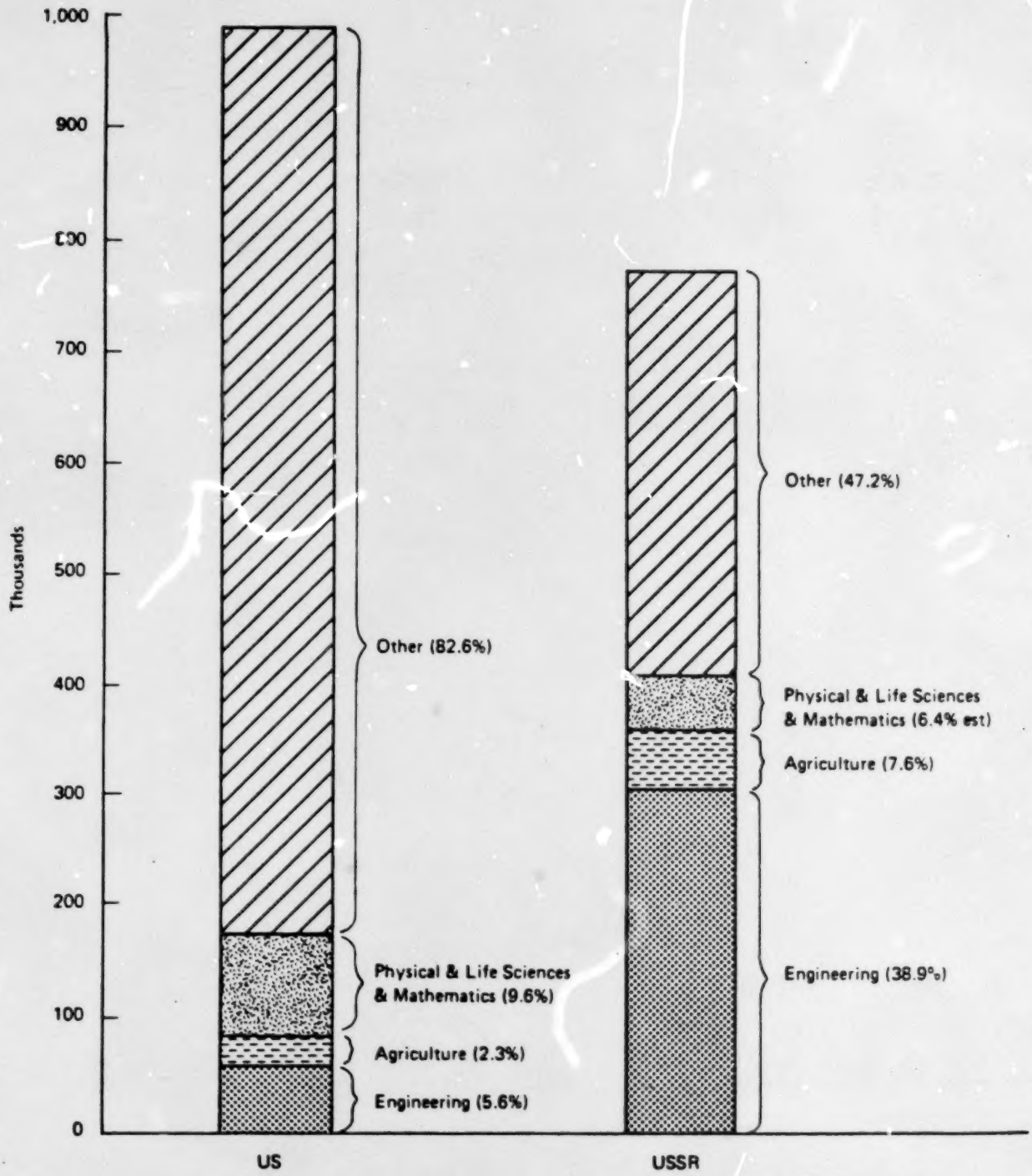
[1] Apart from the specialties in geology-prospecting, geodesy-cartography and hydrology-meteorology, which are classified as 'engineering' by Soviet definitions but which are classified under physical sciences by U.S. definitions, Soviet enrollment and graduation in specialties in the physical and life sciences and mathematics are included in two other of the 22 specialty groups: a large number of specialties in these fields are included in the "university specialties" group and a few are included in the "specialties of pedagogical and cultural higher educational institutions" group. While data are available on enrollment and graduation by specialty group, they are not available by individual specialty. As a rough estimate of enrollment and graduation in the physical and life sciences and mathematics, two-thirds of total enrollment and graduation in "university specialties" plus that in the geology-prospecting, geodesy-cartography and hydrology-meteorology groups has been used in this report.



Source: National Economy of the USSR in 1979; Earned Degrees Conferred, 1977-78, Summary Data, National Center for Educational Statistics.

Figure 5 U.S. BACHELOR'S DEGREES AND U.S.S.R. DIPLOMAS CONFERRED, BY MAJOR FIELD OF STUDY: 1978

doctorate degree, while the Soviet Doctor of Science degree appears to be awarded to persons of greater expertise, particularly in terms of research accomplishments, than the U.S. doctorate degree. Thus, direct numerical comparisons are more useful in illustrating relative trends in graduate education in the two countries than as indicators of net additions to the stock of advanced degree holders.

Relative trends in enrollment and graduations in graduate education in the United States and the Soviet Union are shown in Figures 6 and 7. The U.S.S.R. shows a distinct leveling off in both enrollment and graduation of aspirants beginning in 1967-1968, with enrollment actually declining in the most recent years. The U.S. shows a consistent increase in both enrollment and graduation of graduate students until the mid 1970s, with a leveling off or decline thereafter.

Appendix Table 11 shows the breakdown of graduate student enrollment in the United States and the Soviet Union by major field of study for 1960 to 1974. About 75 percent of Soviet aspirant enrollment is in the fields of science and engineering as compared with about 20 percent of total U.S. masters and doctorate enrollment occuring in these fields. In addition, the percentage of total U.S. graduate enrollment in these fields has been steadily declining since 1960.

It should be noted that the United States has a far greater proportion of graduate students enrolled in the field of education than does the Soviet Union. This has implications for the quality of general training of students in the two educational systems. To the extent that an advanced degree denotes a higher quality input into the educational system, it appears that the United States is staffing its schools, grades K-12 and colleges with persons with more graduate training, and thus of higher quality, than is the Soviet Union.

Appendix Table 12 shows the number of U.S. and U.S.S.R. specialists with advanced degrees (U.S. doctorate degrees and U.S.S.R. Candidate of Science and Doctor of Science degrees) by field. As a quantitative indicator of the magnitude of graduate education in the two countries, these data provide a more realistic picture than do comparisons of figures on graduate enrollment, for the reasons discussed above. The table shows that the Soviet Union now has approximately the same total number of specialists with advanced degrees as does the United States, and more than twice the number of engineers with advanced degrees. From among the major aggregate branches of science, the United States leads the Soviet Union in the number of specialists with advanced degrees in only the social sciences and the humanities. (The data are summarized in Figure 9).

There is no Soviet equivalent to the U.S. masters degree. The Soviet aspirant graduate has completed the required instructional components of his graduate training and has only to complete the dissertation to be awarded the Candidate of Science degree, and thus has a higher level training than a U.S. masters degree holder. Masters degree holders, however, represent a large reservoir of persons with scientific training who fill critical middle echelon positions in U.S. industry and government. In 1978, there were over 300,000 masters degrees conferred by U.S. universities, with about 40,000 in the science and engineering fields (See Appendix Table 10).

Figure 8 shows the number of U.S. masters and doctoral degrees relative to the estimated number of U.S.S.R. Candidate degrees conferred in the engineering fields for 1960 to 1976. When masters degrees are included in assessing the total number of engineers being produced annually with degrees higher than the baccalaureate level, the United States leads the Soviet Union. However, there are substantially more Candidate degrees conferred annually in the engineering fields than doctorates, which is the nearest U.S. equivalent.

enter before age 45. There is no age limit for persons who intend to write and defend a dissertation, but who do not enter formal graduate programs as aspirants. Students undertaking graduate level training are generally supported by either special state stipends or by the organizations for which they work.

For all graduate level students pursuing the Candidate of Science degree, whether through formal graduate instruction or independently, an individual plan of study is set up by the student and his academic committee. Each graduate student is assigned a scientific supervisor (usually a Doctor of Science or Professor) who assists the student in selecting the dissertation topic. Full-time graduate students must do research on a theoretical level in an area or field recognized as being on the frontier of knowledge. Correspondence students generally select a topic related to their jobs and defend their dissertations before the academic councils at the institutions at which they study.

In contrast to Soviet graduate training, the U.S. system of graduate education, although differing in requirements among fields of study and from one university to another, generally involves at both the masters and doctorate level, a set sequence of course work, examinations, research, thesis or dissertation, and defense. The masters degree program is generally from one to two years in duration, while the doctorate requires three to six years depending on field and institution. Graduate degrees in the U.S. are only awarded by institutions of higher education.

There are several important aspects of Soviet graduate training which contrast to that in the United States. Soviet universities, considered by both Soviet and foreign scholars to provide the highest quality training, enroll only about 26 percent of the persons pursuing advanced training while the majority are trained at research institutions. It appears that the research institute-trained students are more oriented toward meeting the needs of the specific institutions at which they study than toward broader training with more of a theoretical and basic science content. This becomes apparent in the dissertation topics selected and approved by the research institutions as opposed to those dissertations supervised at universities. In addition to lectures, Soviet graduate training includes a significant amount of laboratory research related to the current work of the research institution or the contract work currently in progress at the universities. Thus, Soviet formal graduate training programs have more applied science content than do U.S. programs, especially the U.S. doctoral degree level.

Soviet data on enrollment and graduation of graduate students show only those students who are enrolled in formal graduate training (aspirantura) leading to the Candidate of Science degree. Thus, not included in the data are those students who are seeking a Candidate degree without entering a formal graduate program, those students who have graduated from a formal graduate program and are currently studying for Candidate examinations or working on their Candidate dissertaion or defense, and those students who are conducting their research for the Doctor of Science degree. In addition, while data are published on the total number of Doctor of Science and Candidate of Science degree holders in the economy as a whole, data on the number of advanced degrees conferred annually are not published in the Soviet Statistical Handbook.[1] The incompleteness of Soviet published data on number of students pursuing a graduate education and on advanced degrees conferred makes strictly numerical comparisons of U.S. and Soviet graduate education difficult.

Apart from the differences in reported statistics noted above, numerical comparison of Soviet and U.S. graduate education is further complicated by the fact that the levels of qualification of U.S. and Soviet advanced degree holders are not strictly comparable: the Candidate of Science degree appears to be a higher level of qualification than the U.S. masters degree but slightly less than the U.S.

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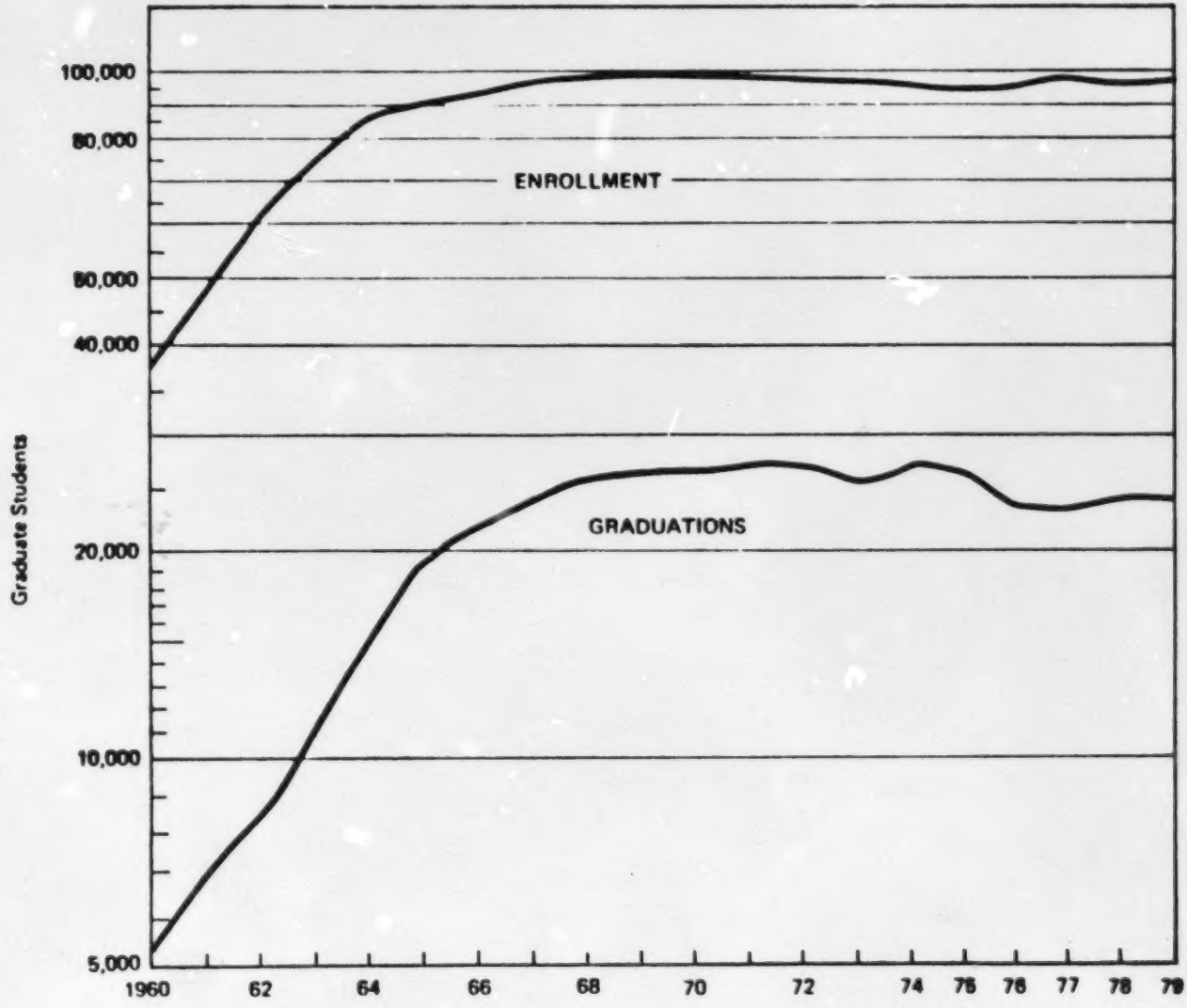
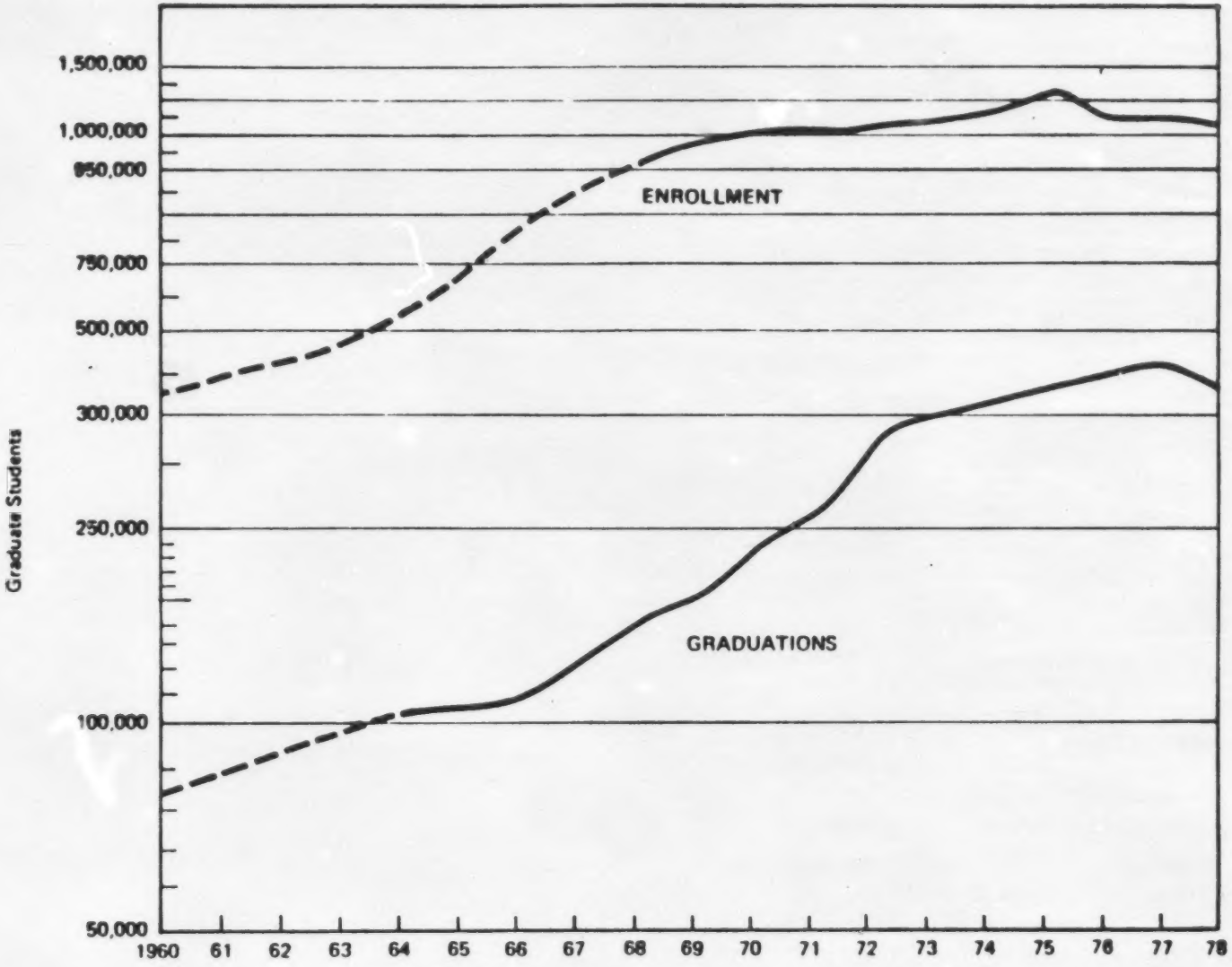
[1] Efforts have been made to estimate U.S.S.R. advanced degrees conferred annually by field of science; see, for example, Joseph S. Conlin Jr., Soviet Professional Scientific and Technical Manpower, Defense Intelligence Agency, ST-CS-01-49-74, October 1973.



Sources: National Economy of the U.S.S.R. in 1961, p. 707; National Economy of the U.S.S.R. in 1968, p. 700; National Economy of the U.S.S.R. in 1963, p. 595; National Economy of the U.S.S.R. in 1975, p. 168; and National Economy of the U.S.S.R. in 1964, p. 705; National Economy of the U.S.S.R. in 1979, p. 110.

Figure 6 U.S.S.R. ENROLLMENT AND GRADUATIONS IN GRADUATE EDUCATION (ASPIRANTS): 1960 to 1979

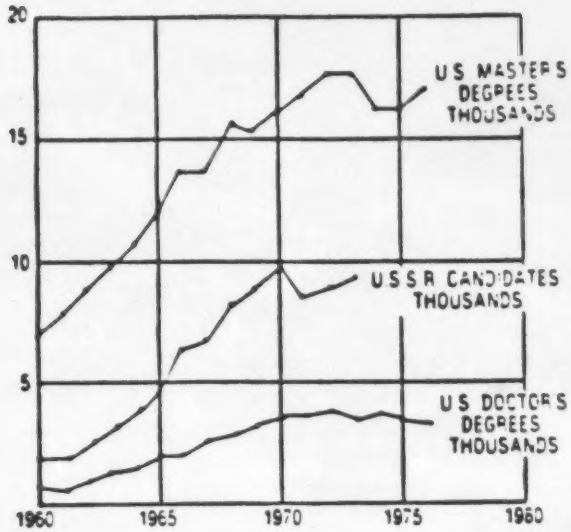


Sources: Statistical Abstract of the United States, 1975, pp. 137, 141;
Statistical Abstract of the United States, 1980, pp. 166, 174.

Figure 7 U.S. ENROLLMENT AND GRADUATIONS IN GRADUATE EDUCATION: 1960 to 1978

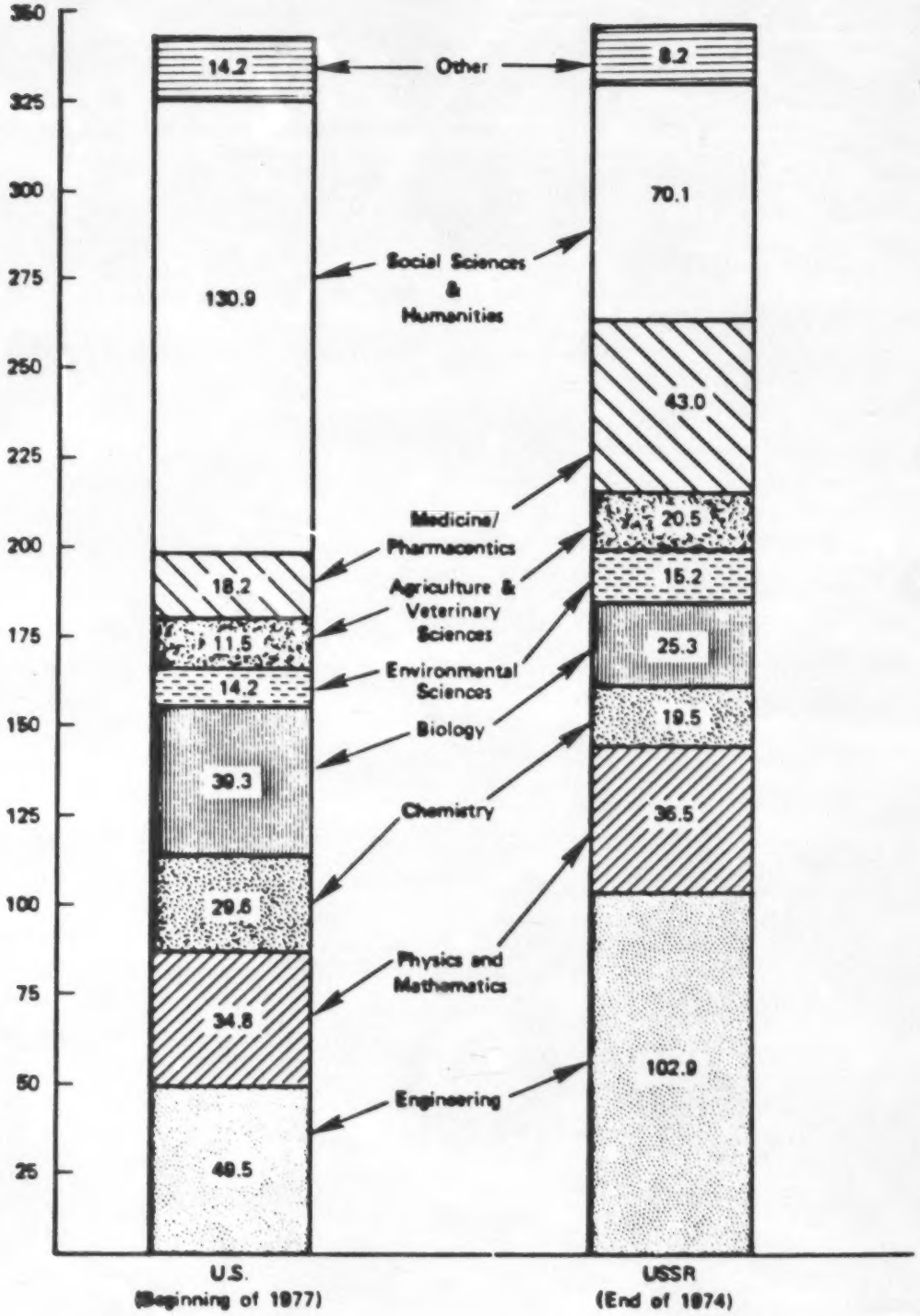
Figure 8

US AND USSR ADVANCED DEGREES CONFERRED
IN ENGINEERING: 1960-1976



Source: Roger K. Talley, Soviet Professional Scientific and Technical Manpower, Defense Intelligence Agency, DST-1830s-049-76, May, 1976.

U.S. AND USSR SPECIALISTS WITH ADVANCED DEGREES*



* U.S. Doctoral Degrees and USSR Candidates of Science and Doctors of Science

Figure 9

APPENDIX

Table 1

U.S. AND U.S.S.R. EDUCATIONAL ATTAINMENT OF THE POPULATION: 1960-1977

	1959-60	1970	1975	1976	1977
U.S.[1]			Percent		
College, 4 Years or More	7.7	11.0	13.9	14.7	15.4
High School, 4 Years or More	33.4	44.2	48.6	49.4	49.5
Fifth Grade, or More	50.6	39.5	33.3	32.0	31.4
Less than 5 Years of School	8.3	5.3	4.2	3.9	3.7
			Number of Years		
Median Level	10.6	12.2	12.3	12.4	12.4
U.S.S.R.[2]			Percent		
Higher	2.6	5.0	6.2	6.4	6.7
Incomplete Higher	1.2	1.6	1.5	1.6	1.5
Specialized Secondary	5.4	8.0	9.8	10.1	10.4
General Secondary	6.8	14.0	17.6	18.6	19.8
Incomplete Secondary	23.0	26.8	27.6	27.4	27.1
Primary and Less	61.0	44.6	37.3	35.9	34.5
			Number of Years		
Median Level	5.9	7.6	8.3	8.5	8.7

[1] Data for persons 25 years of age or older.
[2] Data for persons 16 years of age or older.

Sources: Statistical Abstract of the United States, 1978;
USSR: Trends and Prospects in Educational Attainment, 1959-85, National Foreign Assessment Center, ER79-10344 (June 1979).

TABLE 2

U.S. AND U.S.S.R. TOTAL EXPENDITURES
ON EDUCATION: 1960-1979

	1960	1966	1970	1975	1976	1977	1978	1979
U.S. Total (Billions of Dollars)	24.7	45.2	70.4	111.1	121.8	131.0	104.4	151.5
(Percent of GNP)	5.0	6.3	7.3	7.6	7.5	7.3	7.1	6.7
U.S.S.R. Total (Billions of Rubles)	8.5	14.1	19.8	26.2	27.2	28.2	29.5	30.4
(Percent of GNP)	NA	5.4	5.5	5.8	5.4	5.3	5.3	5.2

[1] Including expenditures from the State Budget (which account for 75 to 80 percent of total expenditures on education) and expenditures financed by collective farms, trade unions and other non-budgetary sources.

Sources: Statistical Abstract of the United States, 1980, p. 140;
National Economy of the USSR in 1979, p. 555;
National Economy of the USSR in 1969, p. 771;
Science Indicators 1978, National Science Board (1979), p. 141.

TABLE 4

U.S.S.R. ENROLLMENT AND GRADUATION FROM SPECIALIZED SECONDARY EDUCATIONAL INSTITUTIONS, BY MAJOR FIELD OF STUDY: 1960-79
(In thousands)

	1960		1965		1970		1975		1976		1977		1978		1979	
	Enrollment	Graduation	Enrollment	Graduation	Enrollment	Graduation	Enrollment	Graduation	Enrollment	Graduation	Enrollment	Graduation	Enrollment	Graduation	Enrollment	Graduation
Geology & Exploration of Mineral Deposits	11.9	2.5	19.9	2.5	24.8	4.8	24.1	5.7	23.9	5.6	22.1	5.9	22.5	5.9	22.1	5.6
Exploitation of Mineral Deposits	42.6	14.1	52.7	6.0	68.2	11.7	56.5	11.1	52.4	11.3	55.8	12.1	49.6	11.6	49.5	10.8
Power Engineering	98.4	15.4	180.4	26.6	218.5	44.8	194.6	47.7	199.1	37.6	198.3	43.9	196.1	44.7	193.7	45.1
Metallurgy	27.1	5.6	41.5	6.8	50.6	10.2	51.6	10.9	54.1	9.5	54.6	11.1	54.9	12.2	54.6	12.5
Mechanical Engineering and Instrument Construction	328.2	74.1	529.4	86.1	572.9	124.0	542.5	125.6	568.6	99.7	577.0	121.7	576.9	128.5	570.7	150.1
Electronics, Electrical Instrument Construction & Automation	45.5	6.8	140.2	18.7	131.5	31.8	142.6	33.8	147.9	27.8	149.9	36.3	151.3	35.2	150.4	36.3
Radio Engineering & Communications	71.1	12.5	140.0	21.8	138.7	30.9	141.7	31.6	144.6	28.1	147.6	33.0	148.2	34.6	147.0	35.8
Chemical Technology	61.5	7.0	90.9	13.4	86.2	21.3	72.6	19.0	76.2	14.6	75.7	18.4	75.5	18.4	75.2	18.6
Timber Engineering and the Technology of Woodpulp, Cellulose and Paper	28.7	6.7	39.7	6.6	46.9	8.5	48.2	10.6	48.9	10.1	48.6	11.0	47.6	11.7	46.5	11.7
Technology of Food Products	66.6	12.0	118.9	18.2	150.7	28.8	164.1	39.5	167.0	39.8	166.8	40.7	169.6	42.4	170.0	43.6
Technology of Consumer Goods Industry	59.7	9.0	102.0	17.2	109.9	24.7	108.4	24.8	111.1	22.1	113.0	24.4	113.5	25.5	113.5	26.6
Building Construction	152.0	34.2	247.7	36.2	362.7	61.9	435.1	99.8	441.0	93.7	436.6	102.6	429.0	104.8	414.1	105.6
Geodesy and Cartography	6.4	1.5	7.3	1.1	9.0	1.5	14.1	2.8	14.7	3.0	15.0	3.1	14.9	3.6	14.5	3.8
Hydrology and Meteorology	6.3	1.4	6.6	1.5	7.2	1.7	7.2	1.6	7.2	1.6	7.0	1.8	6.6	1.7	6.4	1.7
Agriculture and Forestry	292.4	67.2	497.6	68.7	601.1	120.1	645.6	142.1	661.4	144.4	670.6	150.1	678.6	157.3	675.9	161.6
Transportation	112.3	21.3	233.9	33.6	273.0	55.6	294.9	60.4	302.4	62.8	307.6	66.6	306.5	71.1	303.4	71.5
Economics	261.5	71.6	476.8	104.1	622.8	188.6	628.6	208.3	636.1	217.6	639.5	221.6	641.5	230.6	636.7	238.1
Public Health and Physical Culture	176.1	64.4	165.1	76.0	446.2	138.5	430.1	142.0	441.1	142.0	442.1	141.7	441.5	148.9	447.9	150.1
Art	56.6	7.5	97.6	16.1	121.6	21.2	124.6	26.9	125.0	25.9	125.8	26.2	126.2	26.8	126.3	26.9
Education	155.1	47.9	299.0	59.5	169.1	100.0	195.0	109.1	402.9	109.8	410.1	112.1	415.0	111.2	421.5	115.5
Totals	2,059.3	441.5	3,659.3	621.5	4,188.0	1,011.1	4,524.8	1,157.0	4,622.8	1,109.1	4,662.2	1,186.0	4,671.2	1,220.4	4,646.5	1,253.1

Source: The National Economy of the U.S.S.R. in 1979, Moscow "Statistika," pp. 495, 501
The National Economy of the U.S.S.R. in 1970, Moscow "Statistika," pp. 619, 647

TABLE 3

U.S. AND U.S.S.R. SECONDARY SCHOOL GRADUATIONS AND ENTRANCE AND COMPLETION OF HIGHER EDUCATION, 1960-1979

U.S.

Year of High School Graduation	High School Graduates (Thousands)	First Time College Students (Thousands)	First Time College Students as a Share of High School Graduates (Percent)	Year of Graduation from Higher Education	Graduates from Higher Education (Thousands)	Graduates from Higher Education as a Share of Entrants (Percent)
1960	1,864	921	49.5	1964	502	54.4
1965	2,665	1,442	54.1	1969	770	53.4
1970	2,896	1,780	61.5	1974	1009	55.9
1971	2,944	1,766	60.0	1975	988	55.9
1972	3,008	1,740	57.8	1976	998	57.4
1973	3,041	1,757	57.7	1977	993	56.5
1974	3,081	1,854	60.2	1978	998	53.8
1975	3,140	1,910	60.8	1979	NA	NA
1976	3,154	2,377	75.4	1980	NA	NA
1977	3,134	2,432	77.1	1981	NA	NA
1978	3,147	2,422	77.0	1982	NA	NA
1979	NA	NA	NA	1983	NA	NA

U.S.S.R.

Year of Graduation from General Secondary School	General Secondary Graduates (Thousands)	Higher Education Admissions (Thousands)	Higher Education Admissions as a Share of Secondary School Graduates (Percent)	Year of Graduation from Higher Education	Graduates from Higher Education (Thousands)	Graduates from Higher Education as a Share of Entrants (Percent)
1960	1,055	593	56.2	1965	404	68.1
1965	1,340	854	63.7	1970	631	73.9
1970	2,581	912	35.3	1975	711	78.2
1971	2,708	920	34.0	1976	735	79.9
1972	2,886	930	32.2	1977	752	80.9
1973	3,087	938	30.4	1978	772	82.3
1974	3,374	963	28.5	1979	790	82.0
1975	3,566	994	27.9	1980	NA	NA
1976	3,873	1,013	26.2	1981	NA	NA
1977	4,101	1,017	24.8	1982	NA	NA
1978	4,162	1,026	24.7	1983	NA	NA
1979	4,030	1,041	25.9	1984	NA	NA

Sources: Digest of Educational Statistics 1980, pp. 165, 166, 175;
Statistical Abstract of the United States 1971, pp. 130, 137;
Statistical Abstract of the United States 1979, pp. 159, 168, 160;
National Economy of the U.S.S.R. in 1970, p. 646;
National Economy of the U.S.S.R. in 1975, pp. 630, 683;
National Economy of the U.S.S.R. in 1979, pp. 488, 499.

Table 9

U.S.S.R. FULL AND PART TIME GRADUATIONS FROM HIGHER EDUCATIONAL INSTITUTIONS, BY MAJOR FIELD OF STUDY: 1975

	Thousands				Percent Part Time
	Total	Day	Evening	Correspondence	
Engineering	272.1	172.2	53.6	46.2	36.7
Agriculture	53.9	36.0	-	17.8	33.1
Physical and Life Sciences and Mathematics[1]	(44.9)	(29.2)	(4.8)	(10.9)	(35.0)
Other	342.5	195.8	21.4	125.4	42.9
Total	713.4	433.3	79.7	200.4	39.3

[1] Figures are estimates based on two-thirds of graduations in "university specialties" to which graduations in geology-prospecting, geodesy-cartography, and hydrology-meteorology have been added to approximate U.S. definitions.

Source: Calculated on the basis of data contained in USSR: Trends and Prospects in Educational Attainment, 1959-85, p. 30, (National Foreign Assessment Center, ER 79-10344, June 1979).

TABLE 10

U.S. MASTER's DEGREES CONFERRED BY MAJOR FIELD OF STUDY: 1978

Agriculture & Natural Science	4,036
Architecture, Environmental Design	3,121
Area Studies	925
Biological Sciences	6,851
Business and Management	48,661
Communications	3,297
Computer & Information Sciences	3,038
Education	118,957
Engineering	16,409
Fine & Applied Arts	9,036
Foreign Languages	2,741
Health Professions	14,483
Home Economics	2,613
Law	1,786
Letters	10,062
Library Sciences	6,935
Mathematics	3,383
Military Sciences	45
Physical Sciences	5,576
Psychology	8,194
Public Affairs & Services	20,191
Social Sciences	14,660
Theology	3,329
Interdisciplinary Studies	4,487
Total	312,816

Source: Earned Degrees Conferred, 1977-78, Summary Data, National Center for Education Statistics, pp. 28-32.

Table 11

U.S. AND U.S.S.R. GRADUATE STUDENT ENROLLMENT,
BY MAJOR FIELD OF STUDY: 1960-1974

	1960				1965				1970				1974			
	U.S.		U.S.S.R.		U.S.		U.S.S.R.		U.S.		U.S.S.R.		U.S.		U.S.S.R.	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Physical & Life Sciences and Mathematics[1]	58,094	18.5	11,612	31.6	93,594	17.5	29,537	32.7	121,463	14.9	30,057	30.2	137,950	14.3	27,138	28.0
Engineering	36,636	11.7	13,936	37.9	57,516	10.7	35,733	39.6	64,788	8.0	39,979	40.2	56,037	5.8	39,947	41.2
Agriculture	5,493	1.7	2,877	7.8	8,039	1.5	7,323	8.1	10,432	1.3	6,312	6.3	12,601	1.3	5,449	5.6
Education	94,993	30.2	956	2.6	150,300	28.1	1,480	1.6	257,605	31.6	2,097	2.1	327,113	33.9	2,242	2.3
Other	119,133	37.9	7,373	20.1	225,883	42.2	16,221	18.0	361,919	44.3	20,982	21.1	431,299	44.7	22,163	22.9
Total	314,349	100.0	36,754	100.0	535,332	100.0	90,294	100.0	816,207	100.0	99,427	100.0	965,000	100.0	96,939	100.0

[1] Includes both masters and doctorate degree enrollment in biological sciences, computer and information sciences, health professions, mathematics and physical sciences for the U.S.; includes enrollment in formal aspirant training in biology, chemistry, geology and mineralogy, medicine and pharmacy, and physics and mathematics for the U.S.S.R.

Source: Digest of Education Statistics 1979, p. 96, National Center for Education Statistics;
Tables from the Soviet Report on the Training and Utilization of Scientific, Engineering and Technical Personnel in the U.S.S.R., p. 50, (Stanford Research Institute, February 1978).

Table 12

U.S. AND U.S.S.R SPECIALISTS WITH ADVANCED DEGREES,[1]
BY BRANCH OF SCIENCE AND ENGINEERING: 1974-1977
(Actual Figures for United States;
Soviet Figures Rounded to Nearest Hundred)

Branches of Science in which employed	U.S. beginning of 1977		U.S. beginning of 1975	U.S.S.R., end of 1974	
	Number	Per 1000 in Labor Force	Number	Number	Per 1000 in Labor Force
Physical and Life Sciences	147,607	148.3	143,976	160,000	160.3
Physics/Mathematics	34,778	34.9	34,631	36,500	36.5
Physics and Astronomy	17,911	17.9	16,793	-	-
Mathematics	16,867	16.9	17,838	-	-
Chemistry	29,640	29.7	29,548	19,500	19.5
Environmental Sciences	14,170	14.1	13,842	15,200	15.2
Geology/Mineralogy	4,081	4.1	4,023	11,600	11.6
Geography	7,103	7.1	6,140	3,600	3.6
Other Earth Sciences	2,986	2.9	3,679	-	-
Biology	39,324	39.4	38,463	25,300	25.3
Agriculture	10,641	10.6	10,070	17,100	17.1
Medicine/Pharmaceutics	18,164	18.1	16,678	43,000	43.0
Veterinary Sciences	890	0.8	744	3,400	3.4
Engineering (Technical Sciences)	49,481	49.7	44,113	102,900	103.1
Social Sciences	72,526	72.8	-	34,400	34.4
Economics	16,376	16.0	14,408	23,300	23.3
Law (Political Science)	17,735	17.7	-	3,600	3.6
Education	10,467	10.5	-	6,200	6.2
Psychology	27,948	28.0	27,596	1,300	1.3
Humanities	55,355	55.6	-	35,700	35.7
Philosophy/Sociology	10,070	10.1	-	8,000	8.0
Language and Literature	26,040	26.1	-	12,600	12.6
History	14,237	14.3	-	13,400	13.4
Art	5,008	5.0	-	1,700	1.7
Architecture	923	0.9	-	1,100	1.1
Other (U.S.)	13,275	13.8	-	-	-
Other (U.S.S.R.)	-	-	-	7,100	7.1
Total	339,167	340.9	-	341,200	341.8

[1] For U.S., "Advanced Degrees" includes doctorates, for U.S.S.R., they include both Doctors of Science and Candidates of Science.

Sources: Louvan E. Nolting and Murray Feshbach, "R&D Employment in the USSR-Definitions, Statistics and Comparisons" in Soviet Economy in a Time of Change, Vol. I, Joint Economic Committee, p. 750 (U.S. Congress, October 1979); and labor force figures from The National Economy of the USSR in 1974, and Statistical Abstract of the U.S., 1978.